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TESTING FEASIBILITY OF DETECTING POTENTIAL LOCUST BREEDING SITES

Principal Investigator: D E Pedgley

Centre for Overseas Pest Research
College House
Wrights Lane
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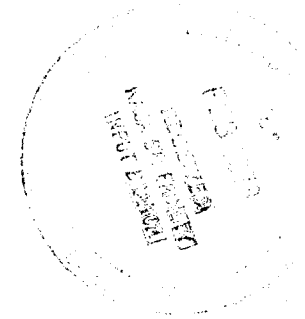
23 January 1973

Type II Report for period
23 October 1972 to 22 January 1973



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15. Abstract. ERTS imagery for gound truth data days is not yet available; hence the feasibility of locating potential locust breeding sites has not been tested. Regular analysis of moisture content in soil samples at 51 places between Jiddah and Badr on the Red Sea coastal plain of Saudi Arabia shows values typically less than 1%. Drying out after rain is rapid: the topmost 0.5 cm can be dry within one day, and 5 cm in about 3 weeks. Because rains are infrequent at the sampling points, it seems unlikely that ERTS will detect occasions when the soil has been recently wetted. If monitoring of vegetation proves feasible, a valuable contribution may be made by ERTS in understanding the current build-up in the test site area of the Desert Locust - possibly leading to a new plague.

Preface

The aim of this project is to test the feasibility of locating potential locust breeding sites by satellite. ERTS-1 is scanning the Red Sea coastal plain of Saudi Arabia for areas recently wetted by rain or where the natural vegetation is growing. Imagery has been available since 24 September 1972, but none so far for days when ground truth data were collected (starting on 22 November 1972). Hence, it is not yet possible to test the feasibility. However, routine analysis of soil samples from a set of 51 places at approximately 5 km intervals along the road north of Jiddah shows that drying out after rain of the dominantly silty and sandy soils is rapid; up to 5 mm of the topsoil is dry after only one day. There is evidence that drying to a depth of 5 cm can occur after about three weeks. Although routine sampling is not planned for other parts of the test site, surveys of vegetation at irregular intervals may yield useful ground truth data. If satellite monitoring of vegetation is proved feasible, it may be possible to use ERTS imagery for September onwards to study vegetation changes in an area near the centre of development of what may turn out to be an upsurge in the Desert Locust plague.

Ground truth data

It is convenient to divide the study area into two:

1. Routine Survey Area, containing a series of 51 sampling points at approximately 5 km intervals along the road northwards from Jiddah towards Medina, as far as Badr (Fig. 1);

2. Test Site Area as a whole, comprising the central and southern Tihamah of Saudi Arabia, i.e. the coastal plain between the Hejaz mountains and the Red Sea (Fig. 2).

1. Routine Survey Area

The part of the central Tihamah containing this area is a gently undulating plain about 10-30 km wide, consisting of silty alluvial fans associated with major wadis coming from the mountains, and intervening sandy or gravelly plains. Wind-blown deposits often cover the foothills of the mountains, and small dunes develop in some places. A few narrow lava flows reach almost to the coast. Saline mud flats (Sebka) fringe much of the coast. Perennial vegetation is sparse - mostly the tufted grass Panicum, and patches of shrubs including Acacia, Tamarix, Leptodenia, Rhazya, Salsola and Zygophyllum. Most of the larger patches are in wadi beds. After good rains, germination of seeds of annual vegetation would turn many of the silty and sandy areas into potential locust breeding sites. Cultivated areas are mostly small, isolated and impermanent.

The Routine Survey Area was chosen for its easy accessability. A good, hard-surface road made it possible to visit all 51 sites in one day or one and a half days. Sampling to the south of Jiddah, particularly between Lith and Qunfidah, although in an area on average more favourable to the occurrence of rain, would have involved difficult logistic problems. Only rough tracks are available, and a day's travel each way would be needed to reach the sampling points. Working in such country for, say, 5-day surveys every 18 days would mean the use of manpower, vehicles and equipment unlikely to be available continuously.

The 51 sampling points were chosen on 15 and 16 May 1972. Their sites were a compromise between (a) uniform spacing, and (b) selection of likely locust habitats. Sites were marked by numbers on road-side posts and on the road verge. Much of the road has been rebuilt (in the past 2-4 years) on a low embankment 2-4 m high so that rain runs off the road surface to produce a narrow strip of unnatural habitat on either side. Hence, samples for soil moisture content were taken 50 m to 100 m from the road, at places which were judged to be (a) relatively undisturbed during the road construction, and (b) reasonably representative of the ground within a radius of a few hundred metres. Soil samples taken at a given place on successive surveys were usually from points within a few metres of each other. Sites could be identified easily among the sparse vegetation from the ground having been obviously disturbed by earlier sampling. Samples of 50-100 g were collected from the top 3-5 mm of soil and sealed in tins. Moisture analyses were made within a few days by a simple gravimetric technique, using an electric oven at 110-120°C for 3 hr. Tests with collected samples, thoroughly wetted artificially and weighed at intervals whilst drying, showed that this treatment was adequate for drying these humus-deficient soils.

Sampling began as planned on 22 November 1972. Soil moisture contents were found to vary between about 1.2 and 0.2%. except for (a) two sites (in silty areas) where it was 2-4%, and (b) three sites in sebka where it was 4-7%. Soils appeared dry to both sight and touch to depths of at least 5 cm, and usually 10 cm. Moist soil was present at depths of 3-5 cm at some of the southern sampling points, presumably as a result of rains on 3 November 1972 - i.e. this depth had dried in 19 days. For comparison, Fig. 3 shows the day-to-day changes in depth of drying out of a plot of silty sand artificially wetted on 27 November. The plot was freely exposed to the sun for most of each day. Maximum daily air temperatures were about 30°C, and dew points were about 20°C. Soil temperatures were not measured but were probably about 40-50°C in nearby dry soil. It can be seen that the field records are consistent with the rate of drying at the experimental plot.

Sampling on 10 December was accompanied by thundery rains over much of the Routine Survey Area. Moisture content was mostly 7-12% at places where rain had fallen during the morning. Evenso, it was noticable on the following day that surface soil had already dried to a depth of 5-10 mm, even though wet soil was present beneath to depths of 10-15 cm. By 28 December, this moisture had gone from most sampling points.

Vegetation sampling consisted of noting its type, density and greenness within a radius of a few hundred metres of each point. Perennial vegetation was sparse, or even absent, at almost all sites, and there was usually little or no green growth. Some small annuals were present at a few places, particularly towards Jiddah, on the edge of a region wetted by heavy rains on 3 November (e.g. 83 mm at Jiddah airport). Ground surveys show that a flush of annuals developed over an area to the east and south of the sampling points. It is likely that the vegetation at all sampling points has been too sparse and dry to be detectable by ERTS imagery. Surveys are planned to continue at 18-day intervals over the next three months at least.

2. Test Site Area

The remainder of the Test Site Area, between Jiddah and Jizan, is similar to the Routine Survey Area, but the interior mountains are higher, and the wadis are larger so that floods more often reach the coast. Cultivations are extensive in the wadis and their deltas south of about 20°N, particularly near Jizan. Lava sheets flood the plain and reach the coast between 18 and 18.5°N.

No routine sampling has been planned for this area. Nevertheless, extensive surveys were made in December, mostly between 19 and 20°N, as part of a mission to survey and control Desert Locust populations. Rains in this area from September onwards had produced extensive areas of annuals, in some places more than 20 cm tall. Boundaries of these green areas were mapped approximately.

This area is presently of particular interest because it has been a favourable habitat over several months for breeding by the Desert Locust. Current information suggests that the part between 18.5 and 19.5°N may well be near the centre of a population that could lead to a renewed plague. Further surveys are expected to be made during the next three months.

ERTS Imagery

ERTS imagery for the Routine Sampling Area has been received, starting with 29 September 1972. No images have yet been received for sampling days (starting 22 November). The images for 29 September show conditions after at least four months of drought (as far as can be judged from available rainfall data). Subsequent images often have much cloud. This is unfortunate but not unexpected, for there is good evidence of above average seasonal rains over the Test Site Area as a whole, except in the north where most of the Routine Sampling Area lies! Thus, the heavy rains of 3 November near Jiddah produced pools of standing water large enough to be seen by ERTS, but the relevant parts of the imagery taken on 4 November, when the satellite passed over Jiddah, are masked by altocumulus clouds.

No images have yet been received for the southern part of the Test Site Area at about the time of vegetation surveys in December.

Conclusions

It has not yet been possible to compare ground truth data with ERTS imagery. Hence no test has yet been made of the feasibility of using ERTS to locate potential locust breeding sites. It seems unlikely on the evidence so far that ERTS will be able to locate recently wetted areas on the Red Sea coastal plain of Saudi Arabia. This is due to a low expectancy of rains in the Routine Sampling Area and the ability of the surface soil to dry rapidly. Exceptions might be when areas of standing water or floods in wadis are persistent for more than the single day apparently adequate for drying of the topmost 5 to 10 mm of soil. The feasibility of detecting growing vegetation, especially annuals, remains untested, but suitable data should become available over the next three months.

It is hoped that the large cloudiness so far experienced will decrease; climatologically this is to be expected.

If ERTS detection of growing vegetation is proved feasible, then imagery for the southern Tihamah from September onwards may throw light on the operational problem of understanding what may well turn out to be an upsurge in the Desert Locust plague. Two possible further side benefits could be (a) direct detection of migrating locust swarms, and (b) added insight into the meso-scale mechanisms of rain production, based on the cloud content of the imagery.

Acknowledgements

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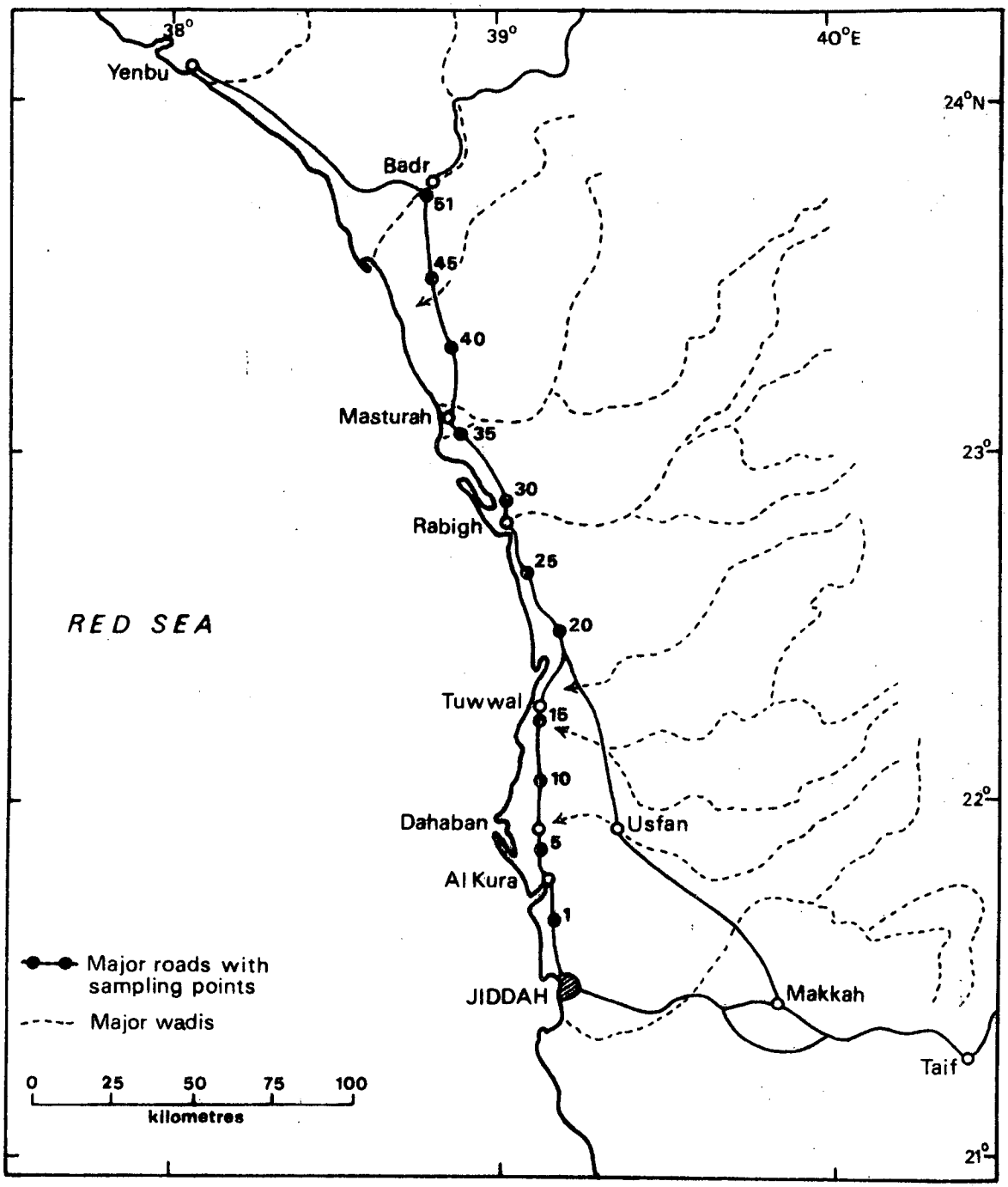

Fig. I Location map showing positions of points for sampling soil moisture and vegetation along the road between Jiddah and Badr, Saudi Arabia.

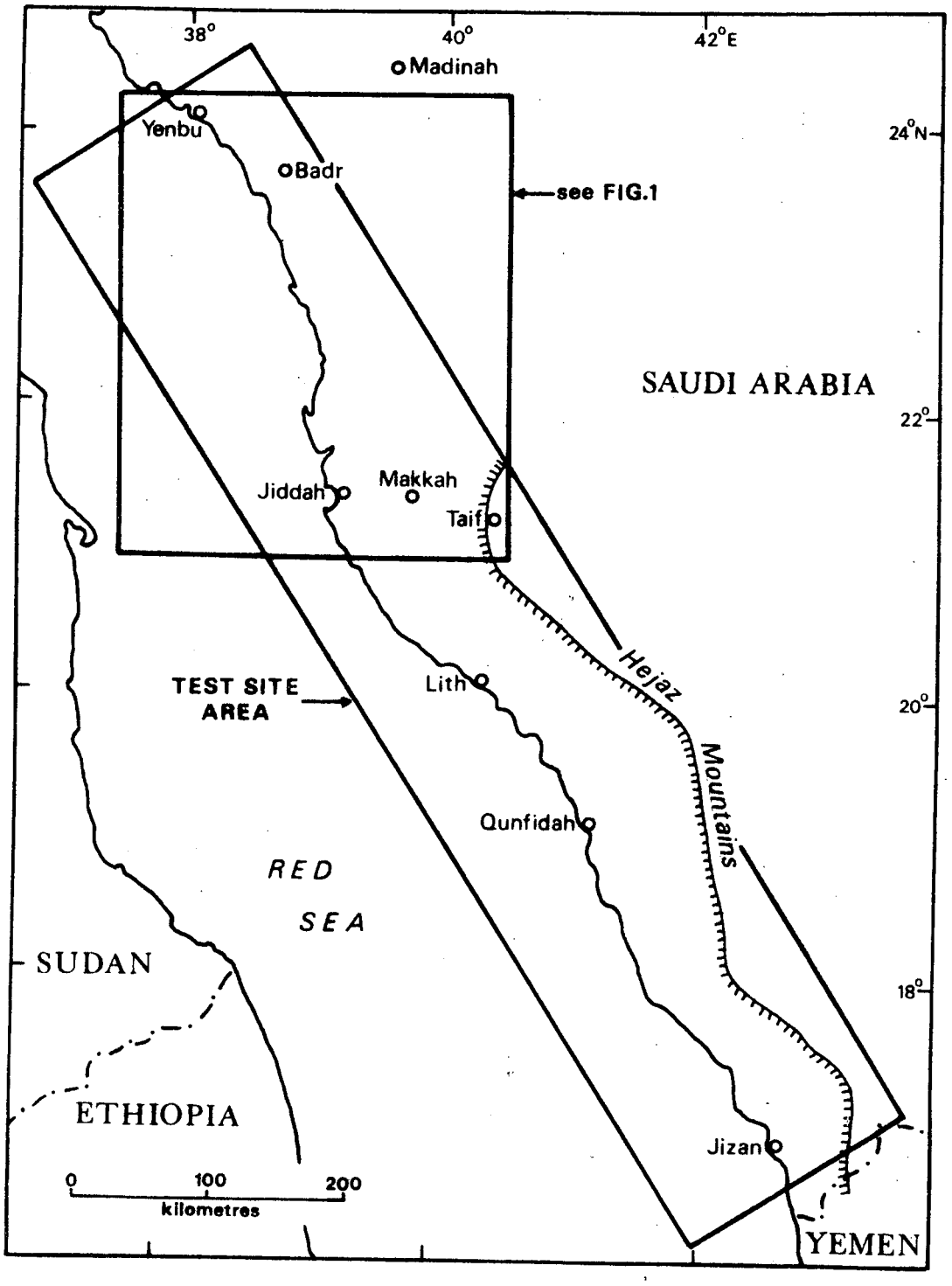

Fig.2 Location map showing the ERTS-I test site area on the Red Sea coastal plain of Saudi Arabia.

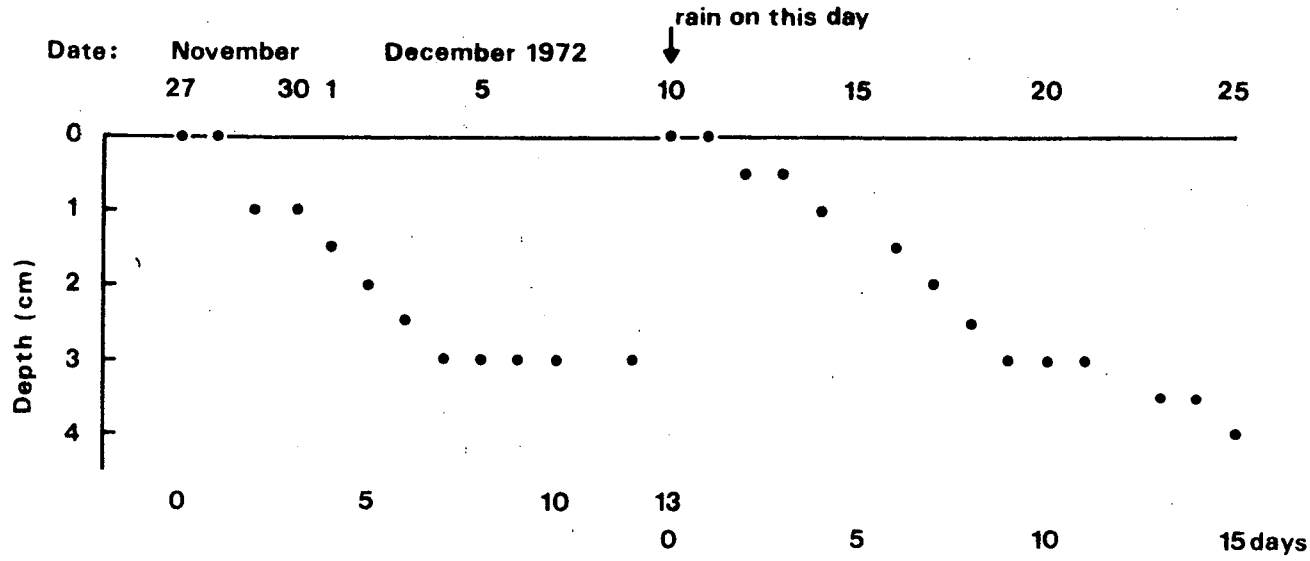

Fig.3 Depth of drying in a sample plot of silty sand wetted on 27 November 1972. Measurements taken at local noon.